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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/804,498	03/19/2004	John W. Hoard	81098602	7702

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EXAMINER	
EDWARDS, LOREN C	

ART UNIT	PAPER NUMBER
3748	

DATE MAILED: 04/18/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/804,498	HOARD ET AL.	
	Examiner	Art Unit	
	Loren C. Edwards	3748	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *24 February 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-28* is/are pending in the application.

4a) Of the above claim(s) *15* is/are withdrawn from consideration.

5)☐ Claim(s) *16-18* is/are allowed.

6)☒ Claim(s) *1-11,14 and 19-25* is/are rejected.

7)☐ Claim(s) *12,13 and 26-28* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *19 March 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. An Applicant's Amendment filed on 2/24/06 has been entered. Claim 15 has been canceled; and claims 1, 11, 16, 18, 19, and 22 have been amended. Overall, claims 1-28 are pending in the application.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

4. Claims 1, 4-5, 11, and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mital et al. (U.S. Pub. No. 2005/0178107) in view of Taylor, III et al. (U.S. Pat. No. 6,843,054) and Hoard et al. (U.S. Pat. No. 6,363,714). Mital discloses a lean NOx trap (LNT) aftertreatment system (Page 3, Paragraphs 42-46), which places an injector (Fig. 1, No. 35) upstream of a non-thermal plasma discharge device (Fig. 1, No. 40). The plasma device receives exhaust from the engine and is located downstream of the injector (Fig. 1; Page 2, Paragraph 14). Mital also discloses the use

of a NOx storage device (Fig. 1, No. 80). Mital fails to specifically discuss the use of a NOx sensor downstream of the NOx storage device, reducing electrical energy applied to the plasma device when the NOx storage device is full, or operating an engine at a lean air-fuel ratio when a signal from the NOx sensor indicates that the exhaust stream contains less than a predetermined concentration of NOx. Taylor discloses a method and apparatus for removing NOx and soot from an engine exhaust gas that teaches the use of a NOx sensor (Taylor, Fig. 3, No. 154) located downstream of a plasma fuel reformer (Taylor, Fig. 3, No. 12), and reducing electrical energy applied to the plasma device when the NOx storage device is full (Taylor, Col. 6, Line 53 – Col. 7, Line 16). Hoard discloses an exhaust system with an emissions storage device and a plasma reactor that operates under lean burn conditions until an NOx sensor has broken a target emission level (Taylor, Col. 5, Lines 20-52). It would have been obvious to one having ordinary skill in the art at the time the invention was made to utilize the NOx sensor and energy control scheme of Taylor for the advantage of being able to sense when and for how long to apply energy to the plasma device in order to reduce the amount of energy consumed by the plasma device. Furthermore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to utilize the air-fuel ratio control as taught by Hoard in the system of Mital for the advantage of increased efficiency in a lean NOx trap system.

5. With regards to claim 4, the modified Mital, as described above, discloses the method of claim 1, and further comprises: increasing electrical energy to the nonthermal plasma discharge device when a signal from the NOx sensor indicates that exhaust

gases contain more than a predetermined concentration of NOx and the NOx storage device is not substantially full (Taylor, Col. 6, Line 53 – Col. 7, Line 16; Hoard, Col. 5, Lines 20-52).

6. With regards to claim 5, the modified Mital, as described above, discloses the method of claim 1, and further comprises: increasing an amount of fuel supplied to the nonthermal plasma discharge device when a signal from the NOx sensor indicates that the exhaust gas contains more than the predetermined concentration of NOx and the NOx storage device is not substantially full (Taylor; Col. 6, Line 53 – Col. 7, Line 16; Hoard Col. 5, Lines 20-52).

7. With regards to claim 11, the modified Mital, as described above, discloses a method for operating an internal combustion engine, comprising: providing an exhaust aftertreatment system coupled downstream of the engine, such exhaust aftertreatment system having an injector (Mital, Fig. 1, No. 35), a nonthermal plasma discharge device located downstream of the injector (Mital, Fig. 1, No. 40), a NOx storage device located downstream of the nonthermal plasma discharge device (Mital, Fig. 1, No.80), and a NOx sensor located downstream of the NOx storage device (Taylor, Fig. 3, No. 154). Mital discusses controlling the fuel and energy provided to the plasma device (Taylor, Col. 6, Line 53 – Col.7, Line 16), determining a desired NO to NO2 conversion efficiency and providing a quantity of fuel and a quantity of electrical energy to the nonthermal plasma device based on the desired conversion efficiency (Hoard, abstract; Fig. 5, and 6; Col. 3, Line 30 – Col. 4, Line 26).

8. With regards to claim 14, the modified Mital, as described above, discloses the method of claim 11 and further wherein the exhaust aftertreatment system comprises a NOx storage device located downstream of the nonthermal plasma discharge device (Mital, Fig. 1, No. 80).

9. Claims 2-3, 6-8, and 19-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mital as applied to claim 1 above, and further in view of Schnaibel et al. (U.S. Pat. No. 6,324,834). The modified Mital discloses the method of claim 1, as described above, but fails to specifically discuss providing exhaust gases with a rich air-fuel ratio when the NOx storage device is full. Schnaibel discloses a method for running an internal combustion engine in conjunction with a NOx-accumulator catalytic converter that runs the engine and subsequently the exhaust gas at a rich air-fuel ratio when the NOx trap is full (Col. 1, Lines 1-30). It would have been obvious to one having ordinary skill in the art at the time the invention was made to utilize the air-fuel ratio control of Schnaibel in the method of Taylor for the advantage of purging the NOx trap without additional mechanical equipment.

10. With regards to claim 3, the modified Mital discloses the method of claim 2, as described above, and further comprises the ability to determine whether the NOx storage device is substantially full (Taylor, Col. 7, Lines 3-4).

11. With regards to claim 6, the modified Mital, as described above, discloses the method of claim 3 and further wherein the NOx storage device is determined to be substantially full based on a model of the engine predicting engine generated NOx (Taylor, Col. 6, Line 53 – Col. 7, Line 16).

12. With regards to claim 7, the modified Mital, as described above, discloses the method of claim 3 and further wherein the NOx storage device is determined to be substantially full based on a signal fro the NOx sensor (Hoard, Col. 5,Lines 21-52).

13. With regards to claim 8, the modified Mital, as described above, discloses the method of claim 3 and further wherein the NOx storage device is determined to be substantially full when a signal from the NOx sensor indicates a NOx concentration exceeding a predetermined concentration (Hoard, Col. 5,Lines 21-52).

14. With regards to claim 19, the modified Mital, as described above, discloses a method for operating an internal combustion engine comprising: operating the engine at a lean air-fuel ratio when a NOx storage device coupled to the engine exhaust is not full (Hoard, Col. 5, Lines 21-52), the NOx storage device is part of an exhaust aftertreatment system, the aftertreatment system further comprising: a nonthermal plasma discharge device located upstream of the NOx storage device (Mital, Fig. 1, Nos. 40 and 80) wherein the nonthermal plasma discharge device receives an exhaust stream from the engine; and providing exhaust gases with a rich air-fuel ratio when the NOx storage device is substantially full (Schnaibel, Col. 1, Lines 1-30).

15. With regards to claim 20, the modified Mital, as described above, discloses the method of claim 19 and further wherein determination that the NOx storage device is full is based on a signal from a NOx sensor disposed downstream of the NOx storage device (Hoard, Col. 5,Lines 21-52; Taylor, Fig. 3, No. 154).

16. With regards to claim 21, the modified Mital discloses the method of claim 19, as described above, and further wherein an amount of electrical energy provided to the

nonthermal discharge device is reduced in response to providing the rich exhaust gases (Hoard, Col. 2, Line 53 – Col. 3, Line 5).

17. Claims 9 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mital as applied to claim 3 above, and further in view of Ali et al. (U.S. Pat. No. 6,775,623). The modified Mital discloses the method of claim 3, as described above, but fails to specifically discuss the engine generated NOx being based on a lookup table based on engine speed and torque. Ali discloses a real-time NOx estimation process that uses engine speed and torque to estimate the amount of NOx generated by the engine (Ali, Abstract). It would have been obvious to one having ordinary skill in the art at the time the invention was made to utilize the NOx estimation as taught by Ali in the method of Taylor for the advantage of accurate and dynamic estimations of NOx.

18. With regards to claim 10, the modified Mital discloses the method of claim 3, as described above, and further wherein the NOx storage device is determined to be substantially full based on a lookup table based on engine speed and torque (Taylor, Col. 7, Lines 5-16; Ali, Abstract).

19. Claims 22-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mital as applied to claim1 above, and further in view of Kokusyo et al (U.S. Pat. No. 6,792,751). The modified Mital discloses a method for operating an exhaust aftertreatment system coupled to an internal combustion engine, comprising: a NOx sensor in an exhaust aftertreatment system that indicates when a predetermined level of NOx has been reached (Taylor, Col. 9, Lines 50-56), wherein the exhaust aftertreatment system comprises a nonthermal plasma discharge device (Mital, Fig. 1,

No. 40) located downstream of the engine, a NOx storage device located downstream of the nonthermal plasma discharge device (Mital, Fig. 1, No. 80), and the NOx sensor is located downstream of the NOx storage device (Taylor, Fig. 3, No. 154). Mital discusses being able to control the fuel to the reformer (Taylor, Col. 6, Line 53 – Col. 7, Line 16) but fails to specifically discuss increasing a quantity of fuel supplied when a signal from the NOx sensor indicates an excess of a predetermined NOx level. Kokusyo discloses an exhaust gas purification device and method that increases the amount of fuel when a NOx trap needs to be purged, i.e. when a NOx level has been exceeded (Kokusyo, Col. 1, Lines 38-57). It would have been obvious to one having ordinary skill in the art at the time the invention was made to utilize the fuel control of Kokusyo in the method of Mital for the advantage of purging the NOx traps.

20. With regards to claim 23, the modified Mital, as described above, discloses the method of claim 22 and further wherein the fuel supplied is by a fuel injector located in the engine exhaust upstream of the nonthermal plasma discharge device (Mital, Fig. 1, No. 35).

21. With regards to claim 24, the modified Taylor, as described above, discloses the method of claim 22 and further wherein the NOx storage device is located downstream of the nonthermal plasma discharge device (Taylor, Fig. 3, No. 12, 84, and 86) and the NOx sensor is located downstream of the NOx storage device (Taylor, Fig. 3, No. 84, 86, and 154).

22. With regards to claim 25, the modified Mital, as described above, discloses the method of claim 22, and further comprising: increasing electrical energy to the

nonthermal plasma discharge device based on a signal from the NOx sensor (Taylor, Col. 6, Line 53 – Col. 7 Line 16; Hoard, Col. 2, Line 52 – Col. 3, Line 5).

Allowable Subject Matter

23. Claims 16-18 are allowed.

24. Claims 12-13, and 26-28 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Response to Amendment

25. Applicant's arguments with respect to claims 1, 11, 12, and 22 have been considered but are moot in view of the new ground(s) of rejection.

26. With respect to the Applicant's arguments on Hoard and the location of its storage device and plasma reactor, the Examiner has considered them but finds them but finds them non persuasive. The Examiner does not rely on Hoard for the location of the exhaust components, but for a system that operates an engine in a lean condition until a predetermined emission level has been reached.

Conclusion

27. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Cho et al. (U.S. Pat. No. 6,959,538); Smaling (U.S. Pat. No. 6,758,035); Tamura et al. (U.S. Pat. No. 6,532,733); Hemingway et al. (U.S. Pub. No. 2002/0076368 A1); Balko et al. (U.S. Pat. No. 6,176,078); Penetrante et al. (U.S. Pat. No. 6,038,853).

28. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Loren C. Edwards whose telephone number is (571) 272-2756. The examiner can normally be reached on M-TH 5:30-4.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Thomas Denion can be reached on (571) 272-4859. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

LCE

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